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Investigating perceptions of pre-service science teachers towards laboratories by using phenomenological pattern

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Abstract

Abstract scientific concepts are made clear thanks to laboratory practices and skills related to scientific thought are developed. In this regard, laboratories distinguish themselves from classes, which are the most special areas of educational environments, with both their materials and differences in use and management. The research objective is to detect perceptions of pre-service science teachers, who have been receiving education in the Department of Science Education in the Faculty of Education, on laboratory environments used by pre-service science teachers. This research consists of three laboratory environments used by pre-service science teachers in courses of General Physics Laboratory, General Chemistry Laboratory and General Biology Laboratory within the context of Science Education training program in the Faculty of Education. Pre-service science teachers were asked to express their opinions on laboratory in a cause and effect relationship by describing them via metaphor within the context of this study. It was detected at the end of research that pre-service science teachers define their perceptions on laboratory by using various metaphors. In this respect, perceptions of pre-service science teachers on General Physics Laboratory can be interpreted as that science can be measured and absolute outcome is achieved; their perceptions on General Chemistry Laboratory can be interpreted as that science is experimental, practical and synthesis; their perceptions on General Biology Laboratory can be interpreted as that science is real life.

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1. Introduction

Education is a process that influences behaviors and attitudes of students but also in which students are equipped with information literacy. While many courses contribute to this process, elementary scientific courses make their presence felt particularly through coefficient scores that belong to questions in central examinations. In this respect, Science courses hold an important place on students learning with their contents suitable for constructive approach, as well as with their materials and environments.

Sciences (life sciences) are a product of humanity's efforts to understand nature while understanding itself (Collette & Chiapetta, 1989; Güzel, 2003). Scientific methods used for researching sciences are combination of observations, experiments, formulation of laws and hypotheses and theories. New discoveries, applying and developing previous information and researching whether it is costly and suitable for modern conditions are achieved with laboratory studies (Petrucci, Harwood & Herring, 2002; Gulten, 2006). Sciences can be defined as association of disciplines which attempt to reveal relationships between organisms and non-living beings by cause and effect reasoning. Various methods are used for teaching these revealed relationships to students. It is a known fact that laboratory holds a significant place among these methods (Cepni, Akdeniz & Ayas, 1995). According to Lucas (1971), students can understand how scientists work, think and obtain new information by using researches. According to Hofstein & Lunetta (2004), laboratory applications allow students to conduct research, solve problems, use their dexterities and develop their communication skills, thereby making learned concepts and relationships between these concepts more meaningful and permanent. Laboratory practices ensure students to develop positive attitudes towards science and scientist and become effective for choosing a science-related profession (Ayas et al., 2002).

Assessing science classes and laboratories by taking students' opinions is a quite preferred method in numerous studies on how to make effective science teaching (Fraser & Walberg, 1991; Fraser, 1994). The context of these studies are based on assumption that a particular learning circle is present in every learning environment, this circle influences both students and teachers and all students in learning environment are more or less affected by this circle. Because, it is stated in conducted researches that there are important relationships between learning circle variable in learning environment and learning products of students, and creating an effective learning circle in a learning environment has a positive impact on learning products of students. Nonetheless, it is also stated that resources other than manpower such as school building, equipment and other instruments need to have an accessory characteristic along with importance of practicability of education programs as much as their design in order to achieve objectives (Fidan & Erden, 1998; Doğan et al., 2002; Chang, Hsiao & Chang, 2011; Türe & Karaküçük, 2011; Partin & Haney, 2012).

Education must be the most dynamic area, which is open to improvement, for social development. Therefore, schools are the most special institutions in educational process. Universities, which are regarded as the highest point of this process, should have the same unique character in this sense. Having researched literature, determination of perceptions of schools in educational process and school role personalities through metaphors has been a subject in many researches (Cerit, 2008; Saban, 2008; Karasolak, 2009; Hacıfazlıoğlu, Karadeniz & Dalgıç, 2011; Uzun & Paliç, 2013).

According to Marlowe & Page (1998), it is argued that learning in constructivist sense, which is related to constructive creation, discovery and developing knowledge, is a) processing of information and also questioning, interpreting and analysis of its outcomes, b) to develop and increase this knowledge and act of thinking, rejuvenation or improvement of meaning with understanding of ideas and thoughts and c) to combine experiences acquired with past experiences (Cited by Yurdakul, 2007). Laboratories are environments which allow for analysis of information and therefore that can provide permanency of learning. Classes, laboratories, extra-class environments and role personalities should be separately investigated. Laboratory studies are quite important in terms of students gaining knowledge in conceptual level and having primary skills necessary for future life. Abstract scientific concepts are made clear thanks to laboratory practices and skills related to scientific thought are developed. In this regard, laboratories distinguish themselves from classes, which are the most special areas of educational environments, with both their materials and differences in use and management. For this reason, perceptions of students on laboratories they use are important to know.

2. The Research Objective

The research objective is to investigate perceptions of pre-service science teachers, who have been receiving education in the Department of Science Education in the Faculty of Education, on General Physics, General Chemistry and General Biology laboratory environments they use.

The problem sentence is; with which metaphors do pre-service science teachers, who participated in this research, explain their perceptions on General Physics, General Chemistry and General Biology laboratories?

Sub problems;

1.Through which metaphors do pre-service science teachers describe their perceptions towards General Physics laboratory? Under which conceptual categories can these metaphors be grouped?

2.Through which metaphors do pre-service science teachers describe their perceptions towards General Chemistry laboratory? Under which conceptual categories can these metaphors be grouped?

3.Through which metaphors do pre-service science teachers describe their perceptions towards General Biology laboratory? Under which conceptual categories can these metaphors be grouped?

3. Methods of the Research

Phenomenological pattern, one of qualitative research methods, was used in this research. Understanding life experiences is primary for phenomenological studies. Phenomenological study provides flexibility to make sense of embedded phenomena with its conceptual structure and to select data collection processes (Munhall, 2007). Phenomenological study is an empirical method which investigates a contemporary phenomenon/situation in-depth within its own real life context in a multi-faceted and systemic way (Yaman & Erdoğan, 2007). Phenomenological pattern focuses on phenomena that we are aware of but we do not have an in-depth and detailed understanding of. Use of metaphors in phenomenological pattern applications allows for easily making sense of life perceived and intended to be analyzed. Albeit the origin of the word metaphor comes from the Greek word “Metafora”, it also has a character that can be defined as transfer or shifting. Metaphor helps defining connection between source and target field by using analogy (Soto, 2006). It helps defining original point and explanation as metaphor by providing expressions like “such as” and “because” in a sentence. Metaphor and analogies are a type of simile to be benefited in order to explain the subject under investigation related to research, and they also ensure conceptualization of ideas. They help abstracting concretely observed things in an investigated situation (Ekiz, 2013). Metaphors are poetic and powerful (Soto, 2006).

This research incorporates three laboratories that pre-service science teachers use including General Physics, General Chemistry and General Biology labs. It was intended in this study to identify perceptions that laboratory environments, in which experiential learning as one of learning methods is achieved, have left on pre-service science teachers through metaphors.

3.1. Data Collection Instruments

Data collection instrument was prepared as a form that consisted of two sections. Some demographic attributes of pre-service science teachers such as gender, age, department, frequency to use laboratories in their high school and university education were provided in the first section of this form.

The following questions are present in the second section:

General Physics Laboratory is like .....; because .....

General Chemistry Laboratory is like .....; because .....

General Biology Laboratory is like .....; because .....

Pre-service science teachers were asked to complete the blanks in these questions. The word “like” was used to determine relationship between the subject and origin of metaphor and the word “because” was used to determine cause and meaning ascribed to a metaphor. All forms were collected from pre-service science teachers however, 36 answers given to General Physics Laboratory, 29 answers given to General Chemistry Laboratory and 23 answers given to General Biology Laboratory were not evaluated because “no metaphor was used in statement”.

3.1. Sample of the Research

The research sample consists of 95 senior pre-service science teacher who have received education in the Department of Science Education in the Faculty of Education.

3.2. Analyzıng Data

Qualitative research method was used in this research. Content analysis was performed for applying qualitative data analysis. Analysis was realized with steps of data organization (coding and determining categories), data summarizing (gathering all data in the same category under a common heading) and data interpretation (interpreting findings through induction) (Büyüköztürk et al., 2009). It was detected that pre-service science teachers used 44 metaphors for General Physics Laboratory; 42 metaphors for General Chemistry Laboratory and 41 metaphors for General Biology Laboratory. Metaphors used were examined by taking their reasoning and common properties into account and they were collected under 8 conceptual category for General Physics Laboratory; 8 conceptual category for General Chemistry Laboratory and 6 conceptual category for General Biology Laboratory. Opinions of experts were asked for questioning whether conceptual categories that were created for metaphors, which emerged for laboratories, were correctly associated in order to ensure reliability of research. Reliability formula of Miles and Huberman (1994) was separately calculated for three labs; it was found 92% for General Physics Laboratory, 92% for General Chemistry Laboratory and 93% for General Biology Laboratory. These results are indicator that research is valid and reliable.

4. Findings

4.1. Demographic findings of research participants

13 participants are male (13.7%) and 82 are female (86.3%); 92 of them are between 18-23 years old and others are 24 years old and older. laboratory in high school it was determined that 13 students (13.7%) have always used laboratory, 28 students (29.5%) have never used a lab but 54 of them sometimes used a laboratory (56.8%). Also, looking at frequency of students to use laboratory in university, it was determined that 49 students (51.6%) have always used laboratory, 1 student (1%) has never used a lab but 45 of them sometimes used a laboratory (47.4%).

4.2. Research findings assessed within the framework of sub-problems.

Problem 1.Through which metaphors do pre-service science teachers describe their perceptions towards General Physics laboratory? Under which conceptual categories can these metaphors be grouped?

Table 1. Distribution of General Physics Laboratory Metaphors according to Categories

Category (n=8)	Metaphor (n=44)	f	(%)
Healthy and concrete learning environment	Simulation, mechanical train concrete (2), order (2), material world, laboratory that makes you love, analytical course, glasses (2), life (5), visual, village, classroom study environment (2), system	14	31,82
Entertaining and fun environment of diversity	Toy store, small atelier, entertainment center (2), play garden (4), movement,	5	11,36
Experiment, proof and problem-solving environment	Energy, potential difference, sea wave, dream, practice (3), solving questions, amperometer, fact, proof	9	20,45
Limited and mediocre environment	Small cave, chicken coop, remote and cold room	3	6,82
Academic and technological environment	Science (2), technology (2), cartoon, car,	4	9,09
Complex and interesting, ambiguous environment	Unknown city streets, riddle human, shopping mall	4	9,09
Tense environment	Electricity (5), dangerous job, amusement park	3	6,82
Environment of team work	Track, game of revealing	2	4,55
Total		44	100

As seen in Table 1, it was determined that pre-service science teachers mostly used “life”, “practice” and “electricity” metaphors for General Physics laboratory.

Problem 2. Through which metaphors do pre-service science teachers describe their perceptions towards General Chemistry laboratory? Under which conceptual categories can these metaphors be grouped?

Table 2. Distribution of General Chemistry Laboratory Metaphors according to Categories

Category (n=8)	Metaphor (n=42)	f	(%)
Healthy and concrete learning environment	Factory (3), the place where we live, puzzle, home (2)	4	9,53
Entertaining and fun environment of diversity	Kitchen (6), witch room, cosmetics store, underground, space, rainbow (2), fridge, school, entertainment environment (3), happiness, amusement park, kindergarten, game (3),	13	30,95
Experiment, Proof and Problem-Solving Environment	Observation, room, experiment area, saving the world, laboratory, test tube, titration, pharmacy (3), reflection, water, riddle,	11	26,19
Limited and Mediocre Environment	Hospital, insufficient room, record room, stench, life, old ages	6	14,29
Academic and Technological environment	Equipped place, a new world, scientific environment 2	3	7,14
Complex and interesting, ambiguous environment	Curiosity, Heisenberg	2	4,76
Tense environment	Risk area, acid, bomb	3	7,14
Total		42	100

As seen in Table 2, it was determined that pre-service science teachers mostly used “kitchen”, “factory”, “game”, “pharmacy” and “entertainment” metaphors for General Chemistry Laboratory.

Problem 3.Through which metaphors do pre-service science teachers describe their perceptions towards General Biology laboratory? Under which conceptual categories can these metaphors be grouped?

Table 3. Distribution of General Biology Laboratory Metaphors according to Categories

Category (n=6)	Metaphor (n=41)	f	(%)
Environment of Investigation, Analysis and where daily life is explained	Natural environment, room, space, zoo and botanical garden (3), surgery, place of investigation (3), garden (3), nature (3), animals and plants, animal kingdom, life (8), forest (3), world of organisms (5), microscope, botanical park	15	36,59
Environment for discovering the unknown	Microscope (2), spaceport, organism, human body, broad universe of new worlds, place with full of surprises, interesting environment (2), new discovery, different world	9	21,95
Healthy and concrete learning environment	World (2), place of experiment (2), scientific laboratory (3), research, connection, journey, classroom, magical manual	8	19,51
Entertaining and fun environment of diversity	Entertainment (3), happy place, my dearest	3	7,32
Experiment and Problem-Solving Environment	Hospital (2)	1	2,44
Limited and Mediocre Environment	Box (2), chicken coop, shelter, untidy home, slaughter house	5	12,2
Total		41	100

As seen in Table 3, it was determined that pre-service science teachers mostly used “life”, “world of organisms”, “nature”, “forest”, “garden”, “zoo” and “place of investigation” metaphors for General Biology Laboratory.

4.3. Examples from Metaphor Statements of Research Participants towards their Perceptions on Laboratory

Tablo 4. Examples from Metaphor Statements of Research Participants towards their Perceptions on Laboratory

Laboratory	Metaphor	Statement
General Physics	Life	"It is like interesting, thoughtful because experiments conducted make physical explanation of some incidents and phenomena that we see in real life to us" "It is vital and fun. It is like looking at phenomena that we encounter in daily life through the lens of science because it explains aspects that we have always encountered in daily life but we have never been curious about and events that we have been curious about but we haven't thought that their answers can be found in classroom. It ensures concretization of the course physics that is seemed abstract".
	Application	"It is like a small atelier with full of electrical and mechanical devices and equipment for learning topics in physics with application because there are devices with mechanisms and equipments that operate with certain systems within to conduct experiments" "It is like a field of practice because physics cannot be learned without practice"
	Electricity	"It is like a fun game that reveals things, which we have always seen in fact but never thought about, because we installed electrical circuits and made velocity and mass calculations" "It is like boring but instructive because we see projections and electric waves in lab"
General Chemistry	Kitchen	"It is like a kitchen because you can mix many components in suitable environments" "It is like a kitchen (chemistry kitchen) because there are different and colored materials everywhere inside bottles"
	Factory	"It is like a factory, manufacturing of food because like a factory, new materials are manufactured from certain materials within a safety circle in certain amounts" "It is like a factory, there are many materials within and it is in operation in a certain functioning"
	Game	"It is like a fun game because we can achieve different reactions" "It is like a fun course and game in group study because it is very exciting to mix chemical materials with each other and waiting for the outcome"
	Pharmacy	"It is like a pharmacy because it makes drugs" "It is like a pharmacy because it is a place of producing materials needed for us to continue our life"
	Entertainment	"It is like a place where entertaining experiments are conducted because we were able to use chemicals that we had not seen before" "It is beautiful, fun and instructive"
General Biology	Life	"It is like the meaning of life because all functions of human life are examined with this way" "It is like life because it explains life"
	Living World	"It is like the world of organisms because it is concerned about organisms" "It is like the world of organisms because in this course we dealt with organisms and made examinations with microscope"
	Nature	"It allows us to investigate organisms in nature and their structure" "It is like a place where everything in nature is presented and where I feel happy because I think that I am interested in plants and animals"
	Forest	"It is like a garden with flowers, a forest because it incorporates all organisms inside" "It is like a forest because we can see elegance of nature in forest"
	Garden	"It is like a big garden because it has a botanical garden with plenty of plant varieties" "It is like a garden full of plants because we examined plants that we had to examine on-site"
	Zoo	"It is like wandering in zoo and botanical park because it was interesting to examine organisms which are quite connected to our life" "It is like a zoo because there were animals like fishes and frogs in the lab that I had in high school"

5. Results

Having examined perceptions of pre-service science teachers on General Physics, General Chemistry and General Biology laboratories that they have used by means of metaphors and within the context of conceptual categories that represent these metaphors according to obtained findings, it was observed that in general similar conceptual categories formed for three different labs. These conceptual categories are "Healthy and concrete learning environment"; "Entertaining and fun environment of diversity"; "Experiment, proof and problem-solving environment"; "Limited and mediocre environment"; Academic and technological environment"; "Complex and

interesting, ambiguous environment" and "tense environment". The category "environment of team work" differs for General Physics Laboratory. Not having the category "academic and technological environment" for General Biology Laboratory also differs for this Laboratory. Examining metaphors used for General Biology Laboratory, a quite intensive differentiation is observed in conceptual categories compared to General Physics and Chemistry Laboratory. In this regard, the categories "Environment of Investigation, Analysis and where daily life is explained" and "environment for discovering the unknown" appeared intensively in this lab and these categories do not exist in General Physics and Chemistry Laboratory. On the other hand, there are also common categories in lesser ratios with General Physics and Chemistry Laboratory such as "Healthy and concrete learning environment"; "Entertaining and fun environment of diversity"; "Experiment and problem-solving environment" and "Limited and mediocre environment". The reason why General Biology Laboratory differs from General Physics and Chemistry Laboratory that use of microscope in General Biology Laboratory in general and investigating plant and animal samples collected from gardens on these microscopes might have made pre-service science teachers perceive this lab environment as a reflection and discovery of daily life.

Examining metaphors that contain created conceptual categories, it is observed that pre-service science teachers have been intensively affected by their perceptions toward materials specific to laboratory where they were present. For instance, metaphors such as science, mechanics, concrete, order, life, system, electricity, atelier, practice, potential, amperometer and technology stand out in General Physics Laboratory; metaphors like factory, home, kitchen, cosmetics store, rainbow, entertainment environment, amusement park, game, laboratory, test tube, titration, pharmacy, water, riddle, stench, life, scientific environment, Heisenberg and acid stand out in General Chemistry Laboratory, and metaphors like life, zoo and botanical garden, place of investigation, nature, animals and plants, animal kingdom, forest, living world, microscope, microscopic living, human body, interesting environment, new discovery, different world, science and entertainment stand out in General Biology Laboratory. It was observed that commonly used metaphors in three laboratories generally contained statements of "science, practice and life". This is an expected outcome; pre-service science teachers used metaphors, which contained these three statements, for three laboratories in different concentrations. It was determined that statements, which contained "science", were intensively used in metaphors used for General Physics Laboratory (perception for presence of measurable and numerically definite results in this lab); statements, which contained "application", were intensively used in metaphors used for General Chemistry Laboratory (the perception that new products are obtained by mixing various chemical materials to each other with use of equipments such as conical flasks and beakers as lab materials mostly in this laboratory, and there is synthesis and material diversity); statements that contained "life" were intensively used in metaphors used for General Biology Laboratory (the perception that dynamics of real life are seen in this lab since plant and animal samples extracted from nature are examined by microscope). In this respect, perceptions of pre-service science teachers on General Physics Laboratory can be interpreted as that science is measurable and definitive outcome is achieved; perceptions of teacher candidates on General Chemistry Laboratory can be interpreted as that science is scientific application and synthesis, and perceptions of pre-service science teachers on General Biology Laboratory can be interpreted as that science is real life.

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